ARMY RESEARCH LABORATORY

Development of a Profiling Scanner

by David Y. T. Chiu and Troy Alexander

ARL-TR-4573 September 2008

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Army Research Laboratory
Adelphi, MD 20783-1197

ARL-TR-4573 **September 2008**

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REPORT DOCUMENTATION PAGE	*Form Approved* *OMB No. 0704-0188*

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED (From - To)**
September 2008	Final	January to June 2008

4. TITLE AND SUBTITLE Development of a Profiling Scanner	**5a. CONTRACT NUMBER**
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S) David Y. T. Chiu and Troy Alexander	**5d. PROJECT NUMBER**
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Research Laboratory ATTN: AMSRD-ARL-SE-EE 2800 Powder Mill Road Adelphi, MD 20783-1197	**8. PERFORMING ORGANIZATION REPORT NUMBER** ARL-TR-4573
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	**10. SPONSOR/MONITOR'S ACRONYM(S)**
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

This report describes the design, operation, and performance of a two-dimensional (2-D) profiling scanner system using 16 laser diodes, 16 photo sensors, and a personal computer (PC) controller. A profiling scanner provides output images that reveal the size, height, and outline or shape of an object. This information can be useful in various military and related applications. The Radiometric Sensor Development and Applications Team of the Sensors and Electron Devices Directorate (SEDD) at the U.S. Army Research Laboratory (ARL), has developed a 2-D profiling scanner system to study its operational characteristics, performance, and effectiveness in detecting targets in the battlefield, and homeland security environments.

15. SUBJECT TERMS

Profiling scanner

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
					David Y. T. Chiu
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**	UU	38	**19b. TELEPHONE NUMBER** *(Include area code)*
U	U	U			301-394-0052

Standard Form 298 (Rev. 8/98)
Prescribed by ANSI Std. Z39.18

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1. Background and Introduction

A profiling scanner provides output images that reveal the size, height, and outline or shape of an object. This information can be useful in a wide range of applications, ranging from simple intrusion detection to monitoring of parts during a manufacturing process for quality control purposes.

To investigate its usefulness in military and related applications, the Radiometric Sensor Development and Applications Team of the Sensors and Electron Devices Directorate (SEDD) at the U.S. Army Research Laboratory (ARL), has developed a 2-D profiling scanner system to study its operational characteristics, performance, and effectiveness in detecting targets in the battlefield, and homeland security environments.

2. Scope

This report describes the design, operation, and performance of a two-dimensional (2-D) profiling scanner system using 16 laser diodes, 16 photo sensors, and a personal computer (PC) controller. Specifically, the following are discussed,

1. Hardware and software design
2. System performance characteristics and capabilities
   a. Output images
   b. Storing of profiling image data, and counting of object crossings
3. Conclusions

3. Hardware and Software Design

The hardware for the profiling scanner consists mainly of a scanner apparatus, and a PC controller. Figure 1 shows picture of the scanner apparatus, which is made up of a 6' x 8' aluminum frame with 16 laser diodes mounted on one side, and 16 photo sensors mounted on the other. Each laser diode is optically aligned with a photo sensor to form a working pair. Each pair operates independent of all others.

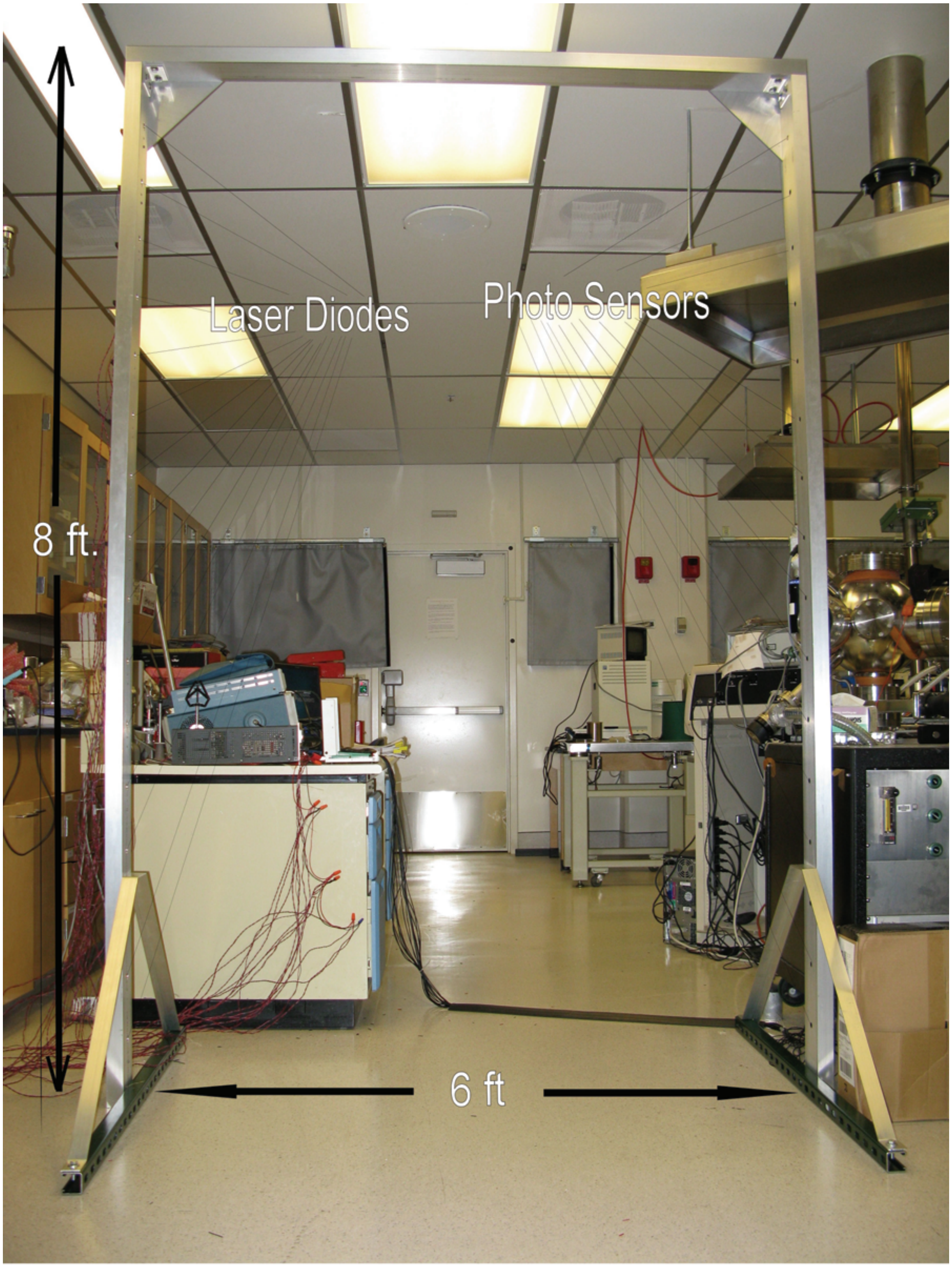

Figure 1. Picture of scanner apparatus showing the 16 laser diodes and photo sensors mounted on each side.

The laser diodes and photo sensors are mounted equally spaced apart. Figures 2 and 3 are close views of the front and back of each leg, showing how they are mounted, respectively.

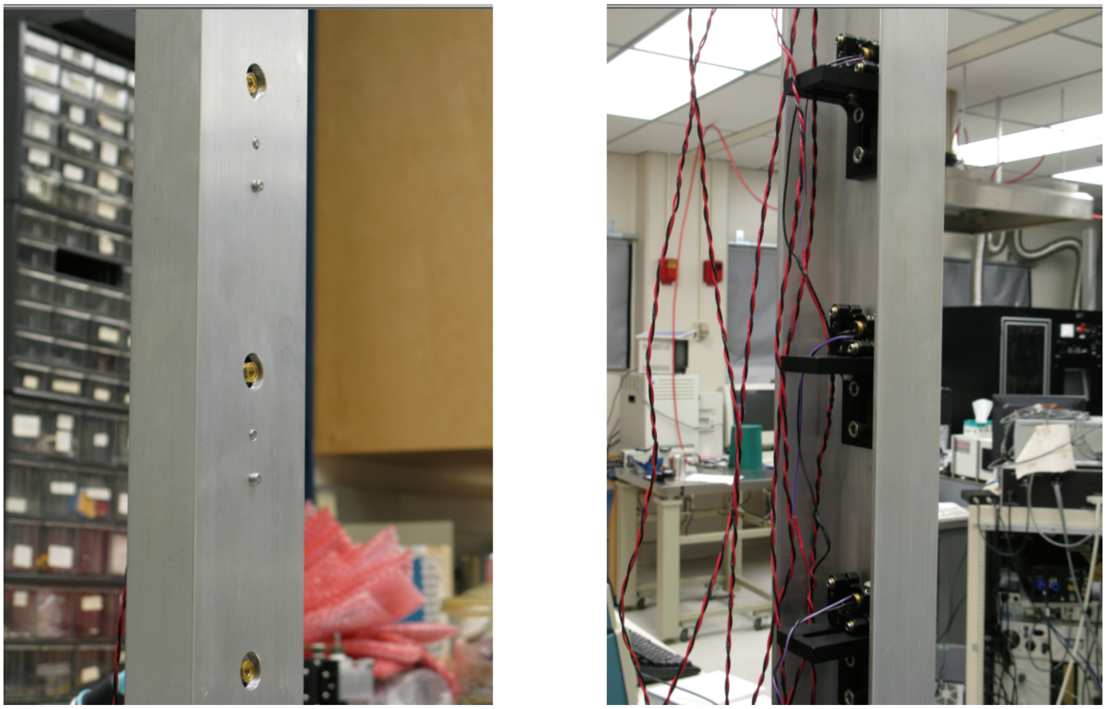

Figure 2. Picture of front and back views of mounted laser diodes.

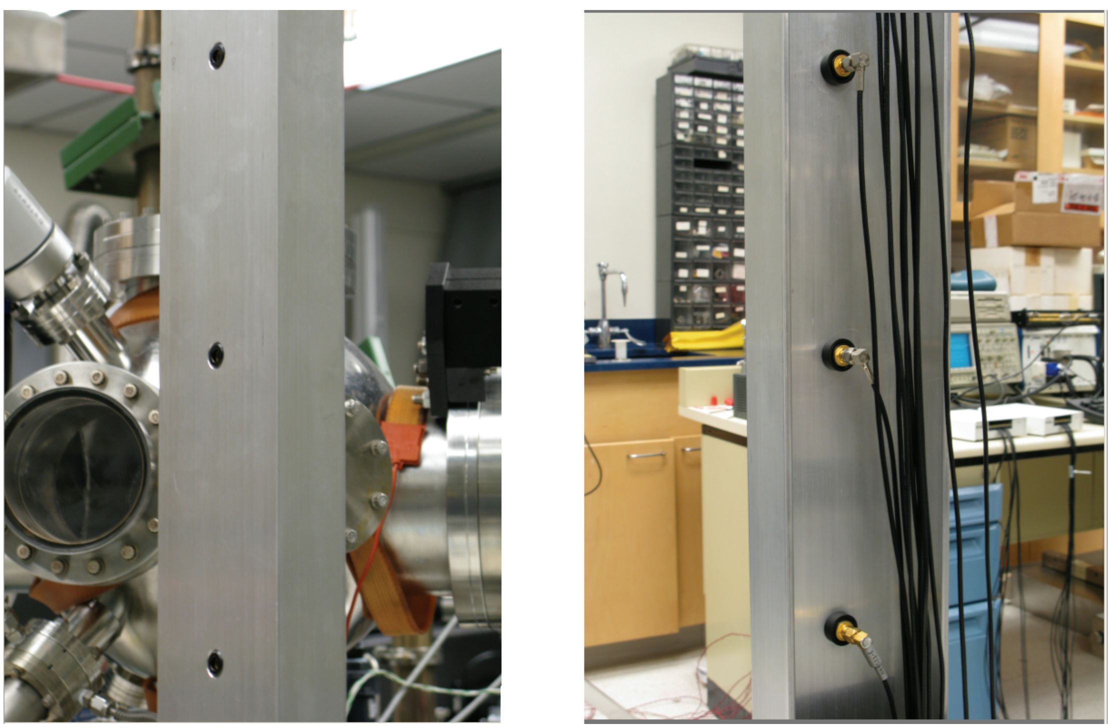

Figure 3. Picture of front and back views of mounted photo sensor.

Mounting fixtures are used on the laser diodes to provide beam alignment to the photo sensor on the other side. The black and red wires are for power connections to a direct current (DC) power supply. Photo sensors are mounted directly on to the frame. A coaxial cable is used to carry each output signal to the PC controller. When power is applied to the laser diodes, each diode generates a beam of focused light which activates a corresponding photo sensor, resulting in 16 channels of sensing beams going across the two legs of the scanner. During operation, when nothing is in between the two legs, each of the photo sensors outputs a constant and continuous analog voltage. The beam is blocked when an object is placed between the laser diode and photo sensor, resulting in a zero voltage output. Operation of the system primarily involves the continuous sensing, monitoring, and processing of the activities of each of the 16 beams. A PC controller provides controls for all operations.

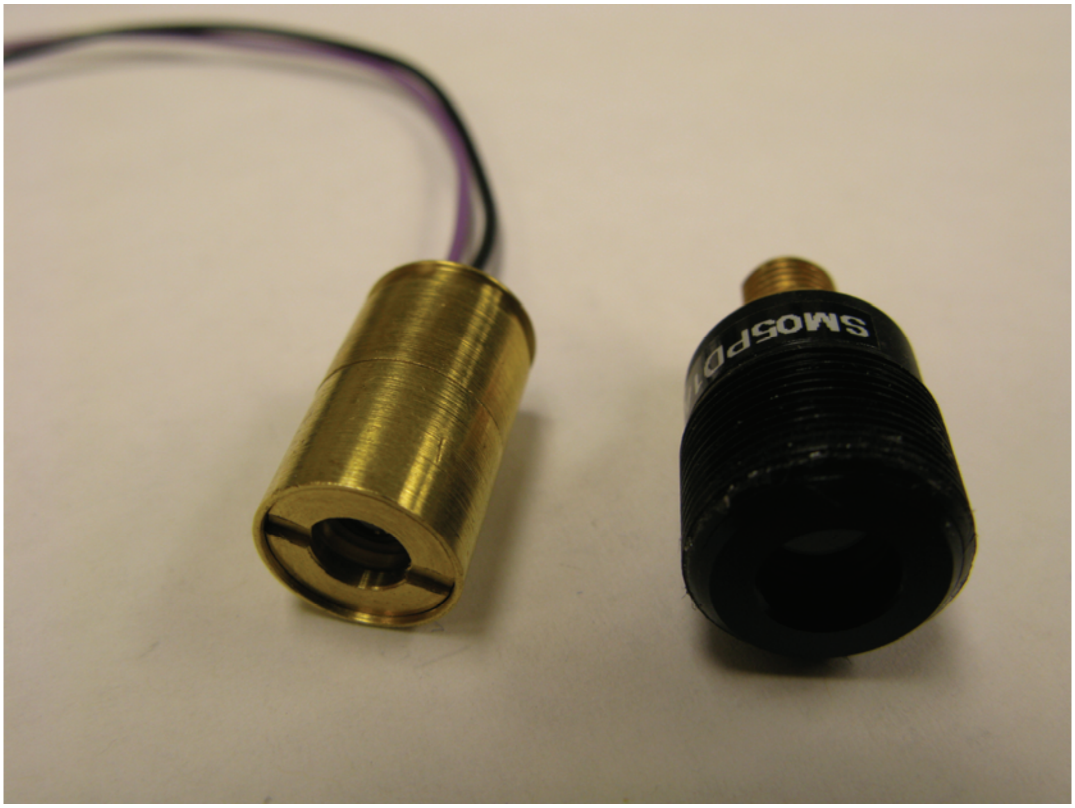

Figure 4. Picture of the laser diode (left) and photo sensor (right).

Figure 4 shows the laser diode and the photo sensor. The laser diode is the M635-5 from US-Lasers, Inc., it operates at 635 nm with 5 mW of output power, and the photo diode is the SM05PD1A from Thorlabs, Inc. Their specifications can be found on the respective website at http://www.us-lasers.com/n635nm5m.htm, and http://www.thorlabs.com/thorProduct.cfm?partNumber=SM05PD1A. Each laser diode is powered by a continuous DC nominal voltage of 2.5 V. A total of about 500 mA is required to power all 16 laser diodes. The photo diode requires no power.

The PC controller is from National Instruments, consisting mainly of the PXIe-8106 embedded controller in a PXIe-1062Q chassis, along with the PXI-6255 data acquisition module (DAQ). Their specifications can be found at the respective website through the following links: http://sine.ni.com/nips/cds/view/p/lang/en/nid/203441, http://sine.ni.com/nips/cds/view/p/lang/en/nid/202664, and http://sine.ni.com/nips/cds/view/p/lang/en/nid/203008.

Figures 5 and 6 show views of the PC controller and the complete controller hardware setup.

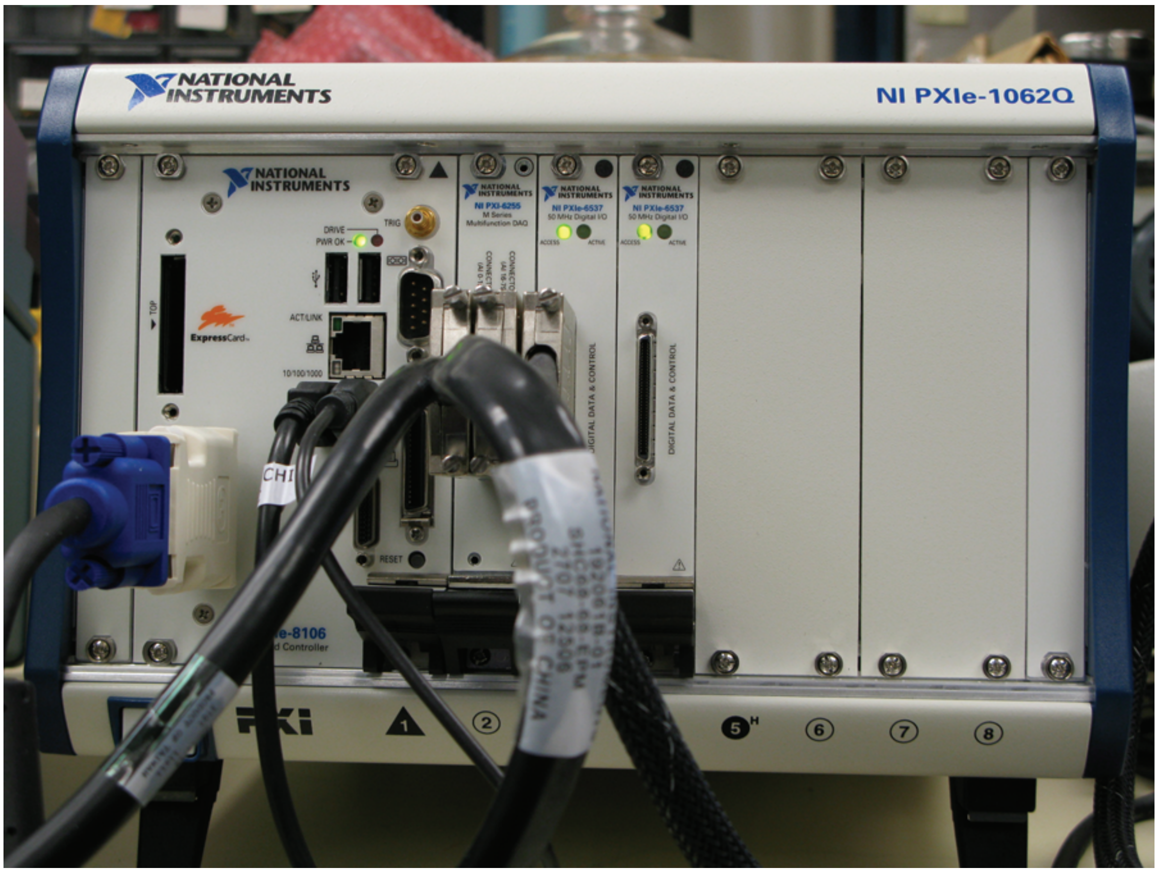

Figure 5. PC controller.

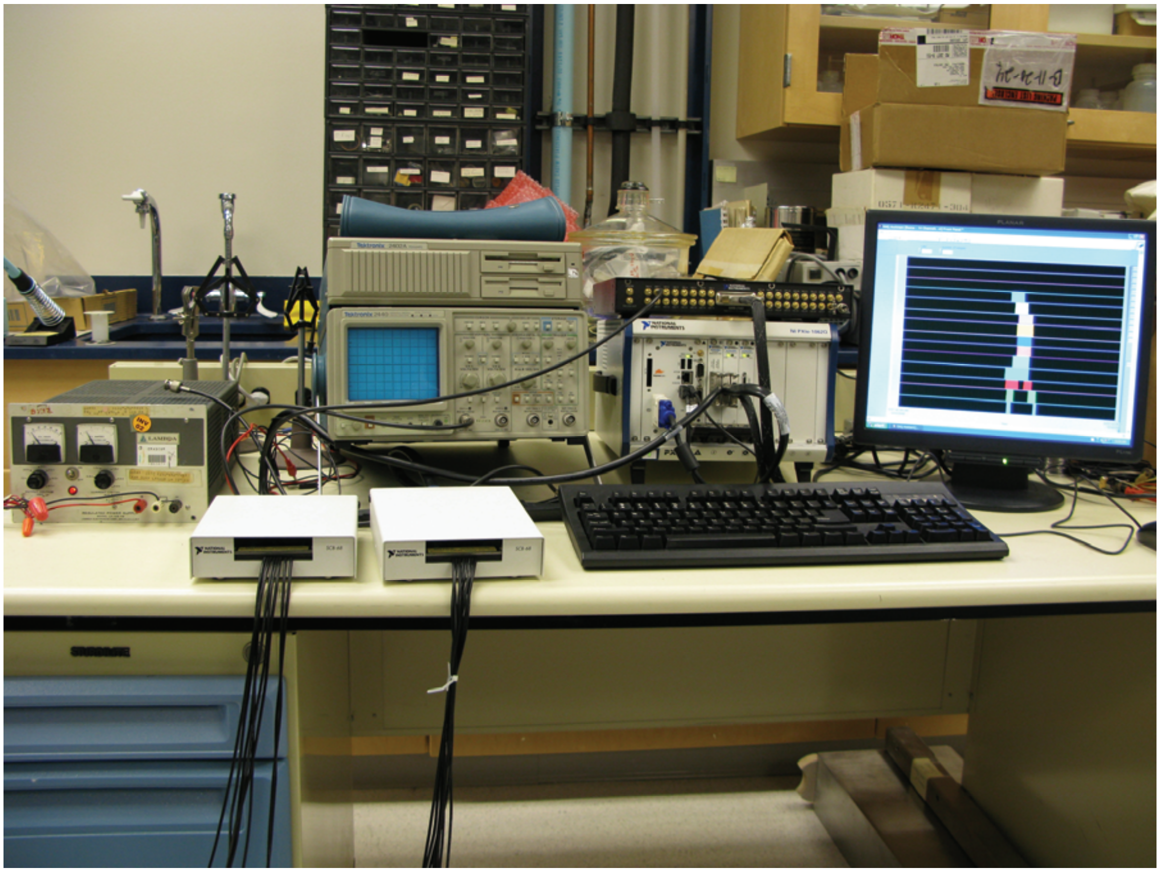

Figure 6. Complete controller hardware setup.

The interface between the DAQ and the sensing signals is via coaxial cables connecting from the photo sensors to two interface boxes. To minimize noise, the signals are connected in differential mode, with each of the 16 signal and ground pairs taking up one DAQ channel for a total of 32 DAQ channels. Figure 7 shows how the 16 coaxial cables are divided into two 8 coaxial bundles, each connecting to an interface boxes. Outputs of the interface boxes connect to the PXI-6255 DAQ module in the PC controller chassis.

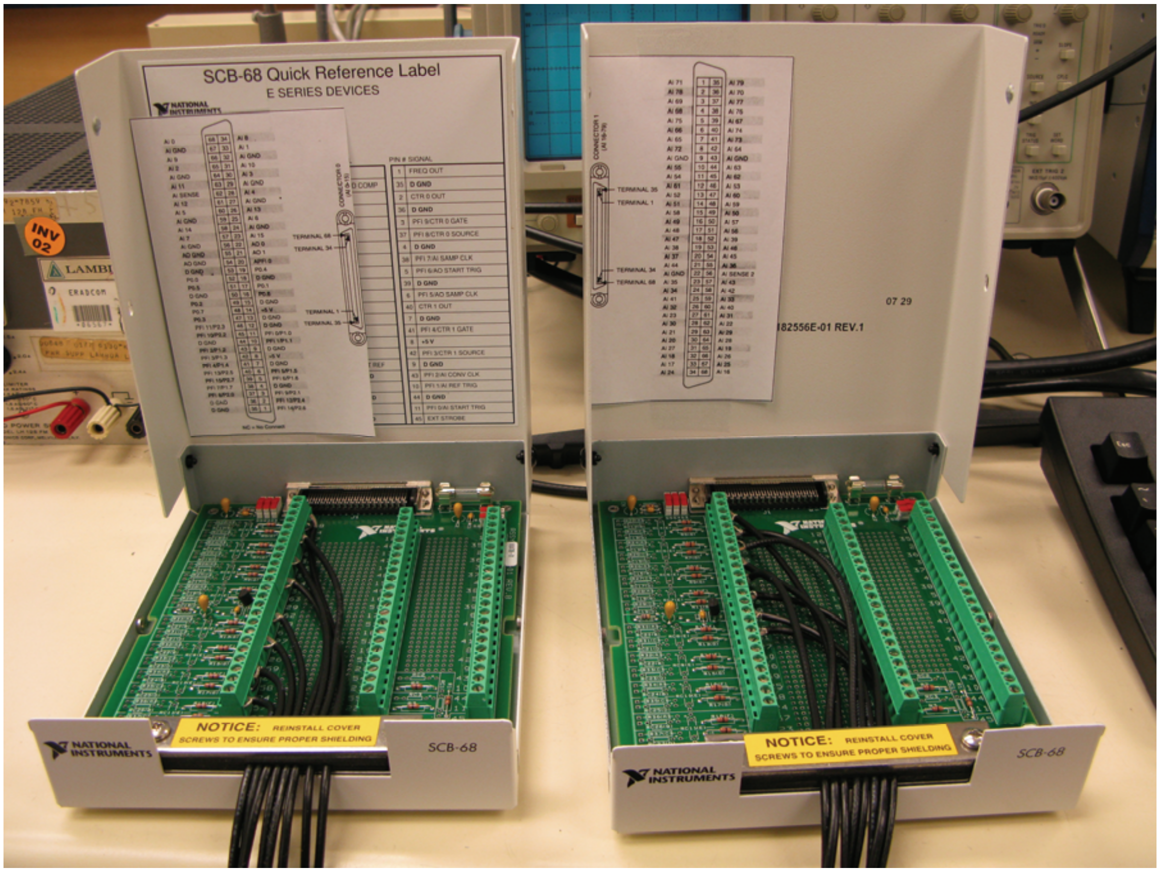

Figure 7. View of coaxial cable connections to the two interface boxes.

A LabVIEW program provides the controls of all system operations; it includes the interfaces, monitoring, detection, processing, and display of all signals from the photo sensors. Appendix A shows the Front Panel and Block Diagram of the LabVIEW program. The program runs in a continuous mode. During operation, the 16 analog signals are first digitized according to the sampling rate and operating frequency settings on the DAQ, the resultant signals are then converted to just 1's and 0's depending on a set threshold level. A "1" here represents when a beam is broken or when something is detected between the laser diodes and the photo sensors, and a "0" means the beam is not broken or no detection. These signals are then stacked together according to their position on the scanner apparatus to form the 16-channel Y-axis on the output display plot, with the X-axis being the scanning time. With appropriate settings on the scan frequency and number of samples, the output plot shows a real-time moving profile image of objects as they move across the scanner apparatus. The area under each of the 16-channel Y plots is filled with a solid color so that a solid profile image of the object is shown.

4. System Performance Characteristics and Capabilities

4.1 Output Images

The key objective in developing the scanner is to see what kind of output profiling images can be obtained, and to determine if the images have the sufficient details needed for target detection type applications. Figures 8 through 11 show examples of different object images obtained with the scanner.

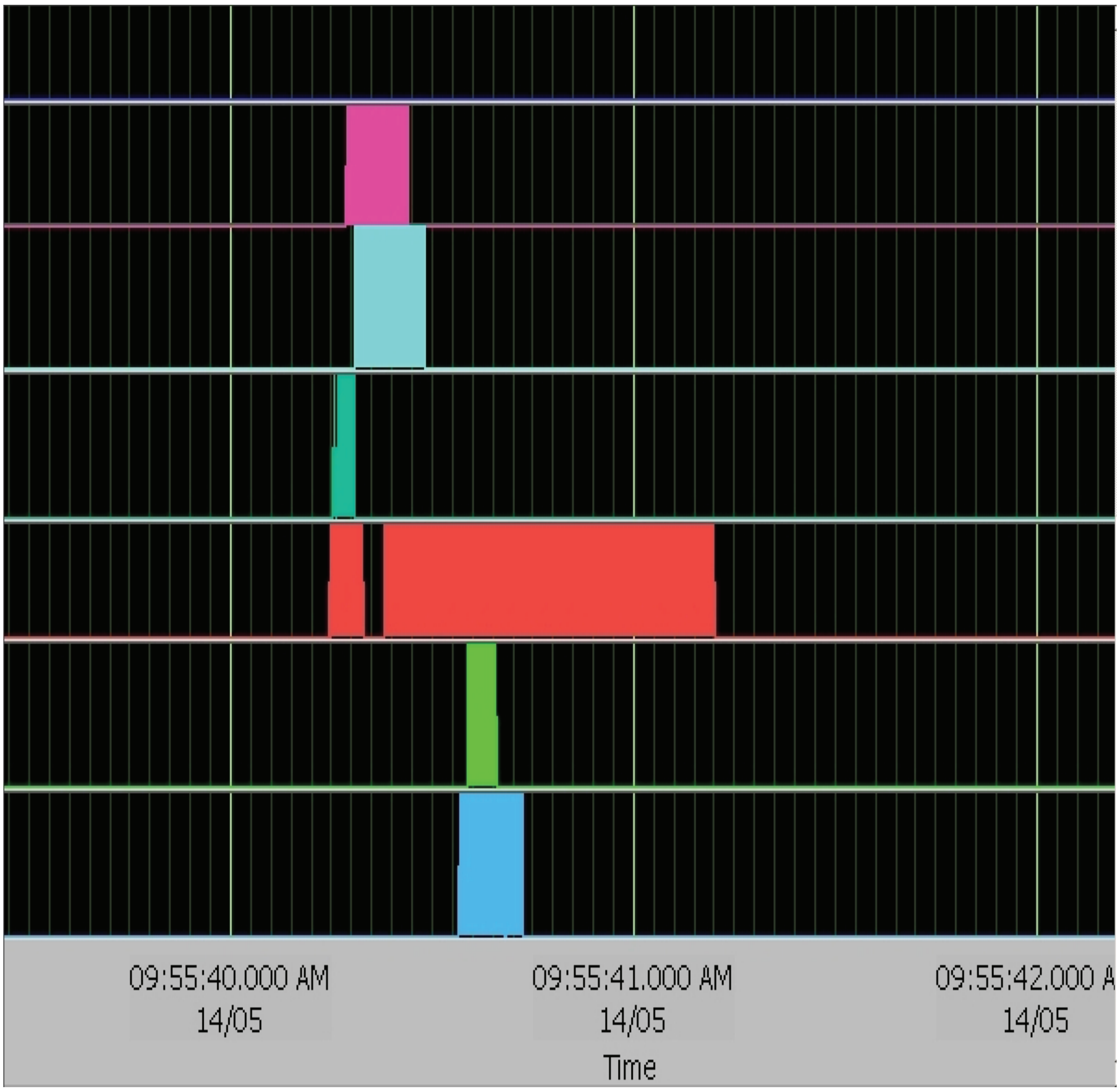

Figure 8. Image of a chair from the scanner.

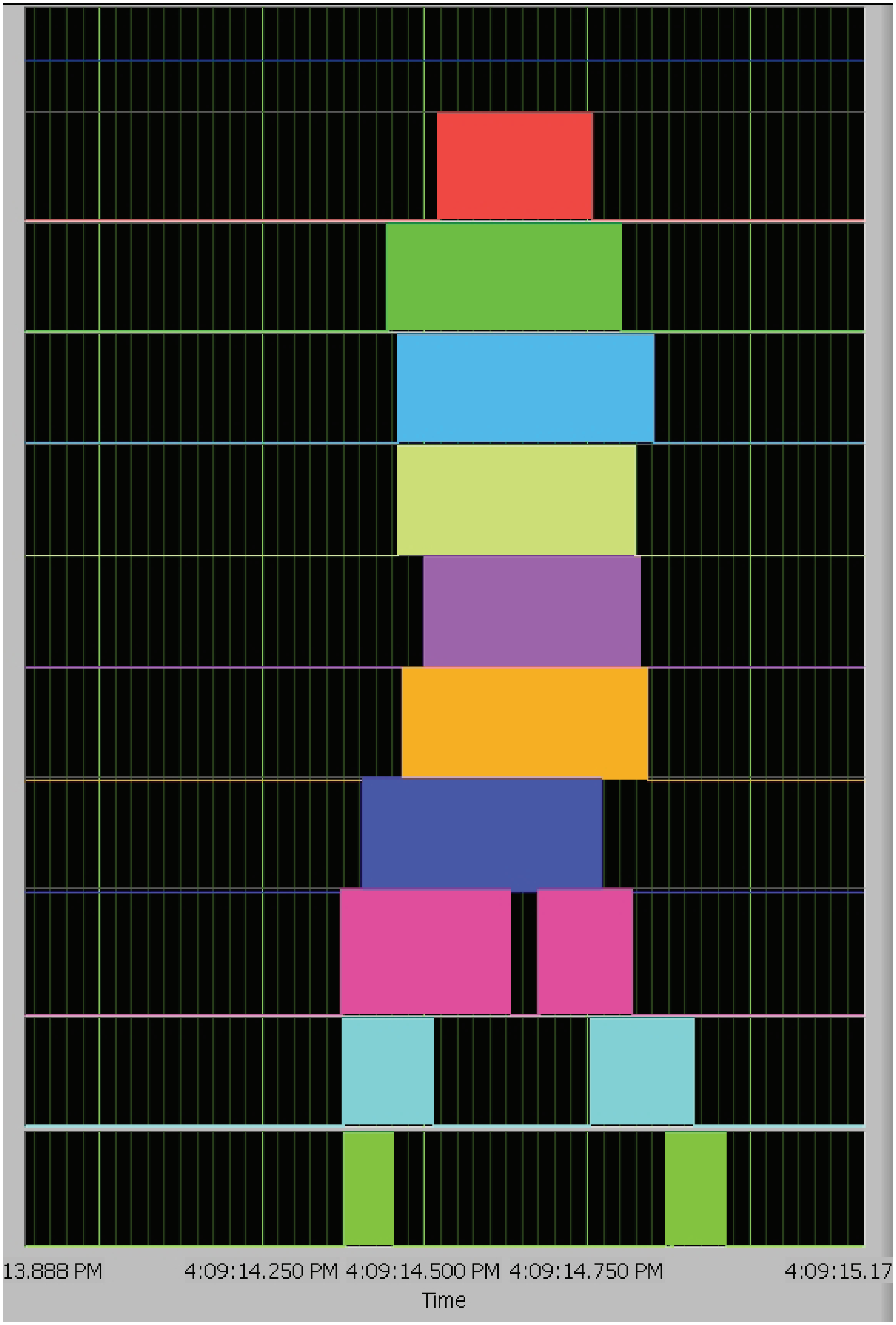

Figure 9. Image of a person from the scanner.

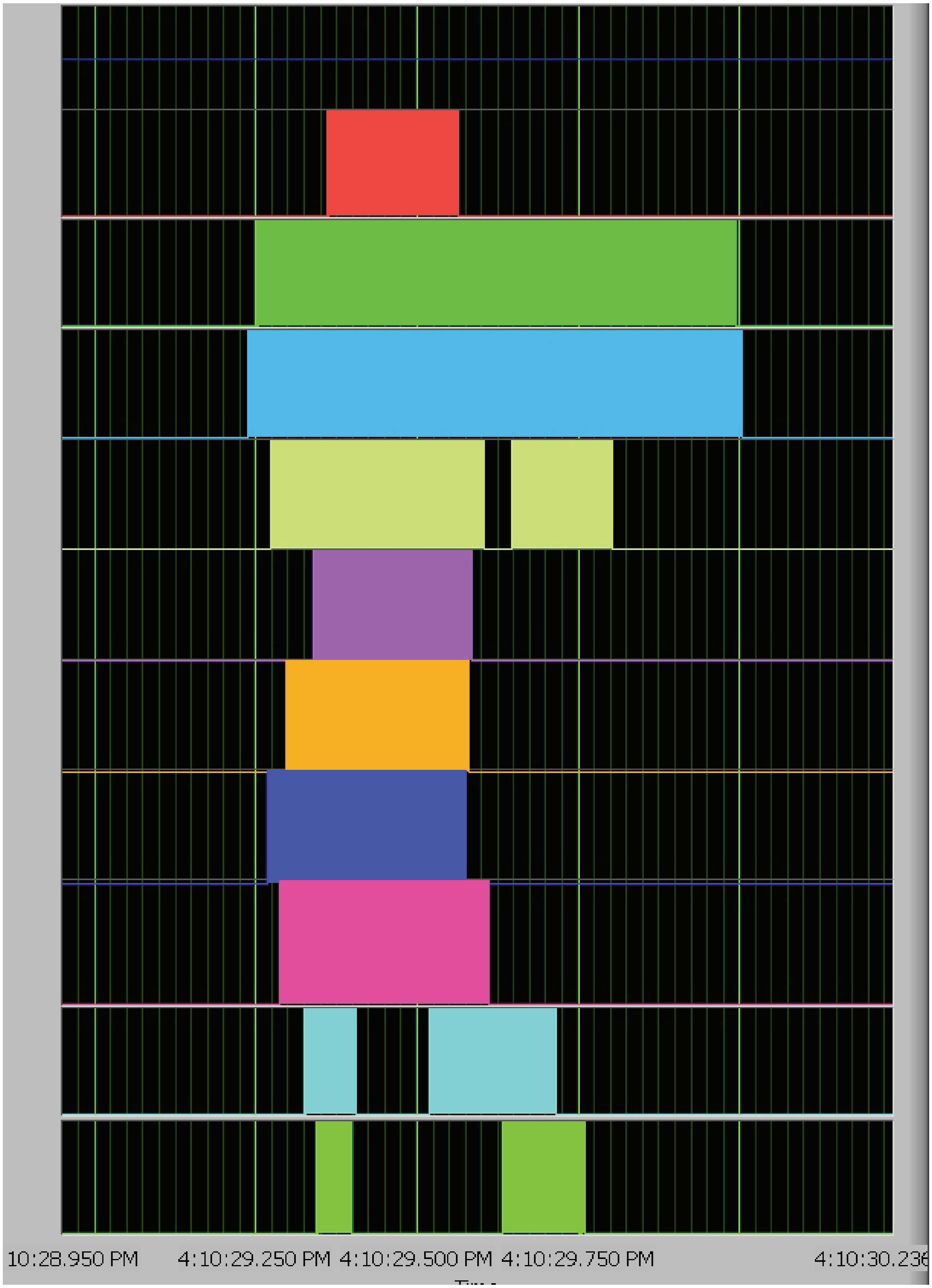

Figure 10. Image of a person with a backpack from the scanner.

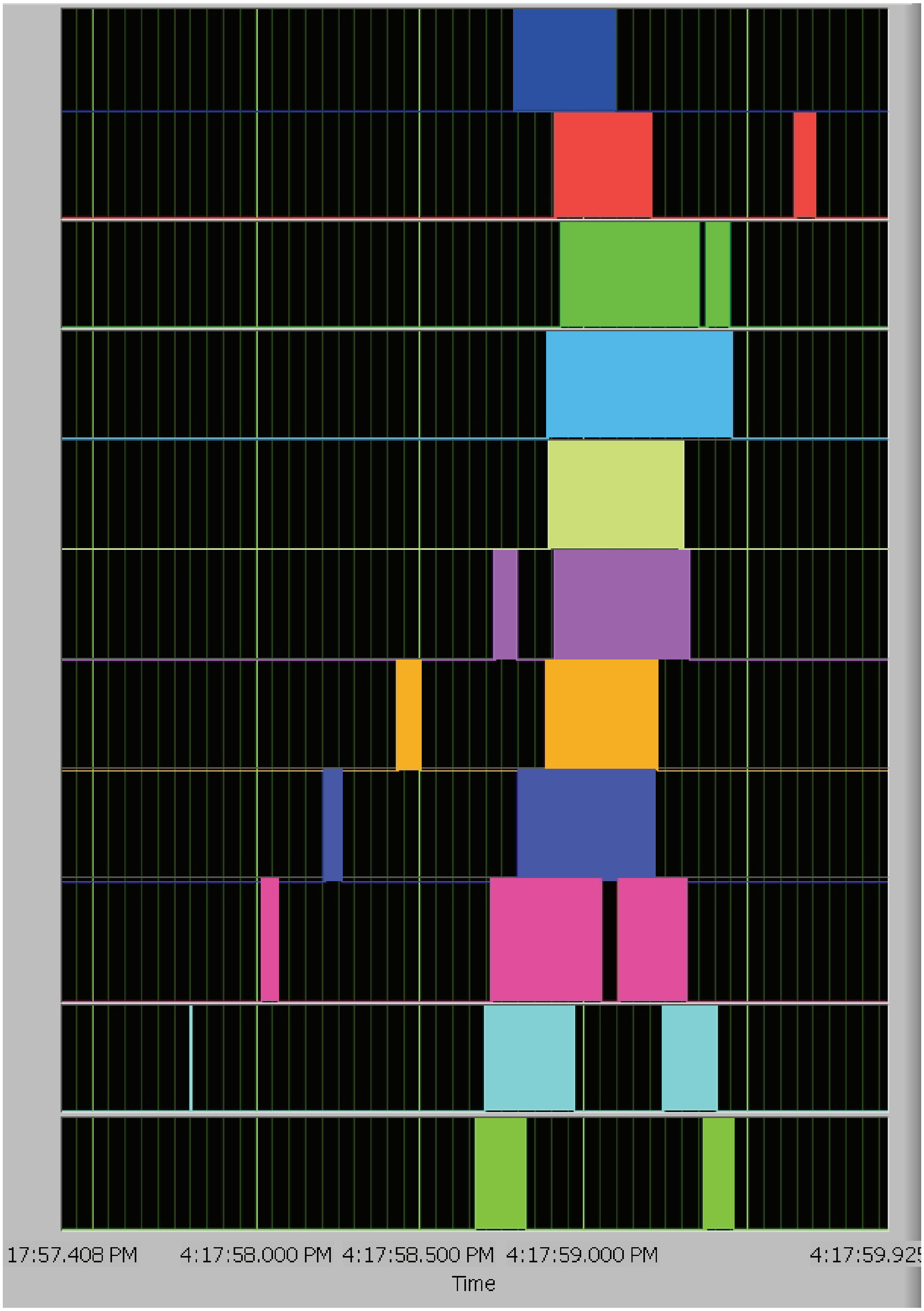

Figure 11. Image of a person carrying a long object.

The vertical resolution of the images is limited here by the number of sensors (equally spaced apart), which is 16. The x-axis time scale is set to accommodate for the speed of objects moving across the scanner at about 4.8 km/h (3 mph), which is about the average walking pace or speed of a person. The scanning rate is about 500 Hz. As shown, these images portray enough details about the size and height, in addition to the shape of the objects to allow one to distinguish between a person and a chair, a person carrying a back pack, and a person holding a long object. They obviously do not have the detailed resolution that can be obtained from a camera; however, in some applications, these lower resolution profile images may be adequate. For example, this type of image can be sufficient to distinguish a person from an animal crossing a border when used in a homeland security application; or as a supplement or aid to other sensors for detection and identification confirmation of enemy troop and vehicle movements when used in a battlefield; etc. In these situations, in comparison to systems using camera, the profiling scanner offers a lower cost alternative in terms of design complexity, and operating data rate or bandwidth requirement.

4.2 Storing of Profiling Image Data and Counting of the Number of Object Crossings

The ability to classify target in a detection and identification system is a useful feature. Profile image data from a scanner can be stored as a signature file that can later be used in a classification system to determine target classification. Figure 12 shows a sample picture of a profile image, and its corresponding signature file saved in Windows xls format shown in appendix B. The scanning frequency here was set at 500 Hz with 50 sampling points. As such, each line in the signature file represents one scan for all the channels with duration of 2 ms. As shown in appendix B, the signature of the object on figure 12 starts at time equals 4:50:06.678 and ends at 4:50:07.326 for a total of 325 scans, for a duration of 0.648 seconds.

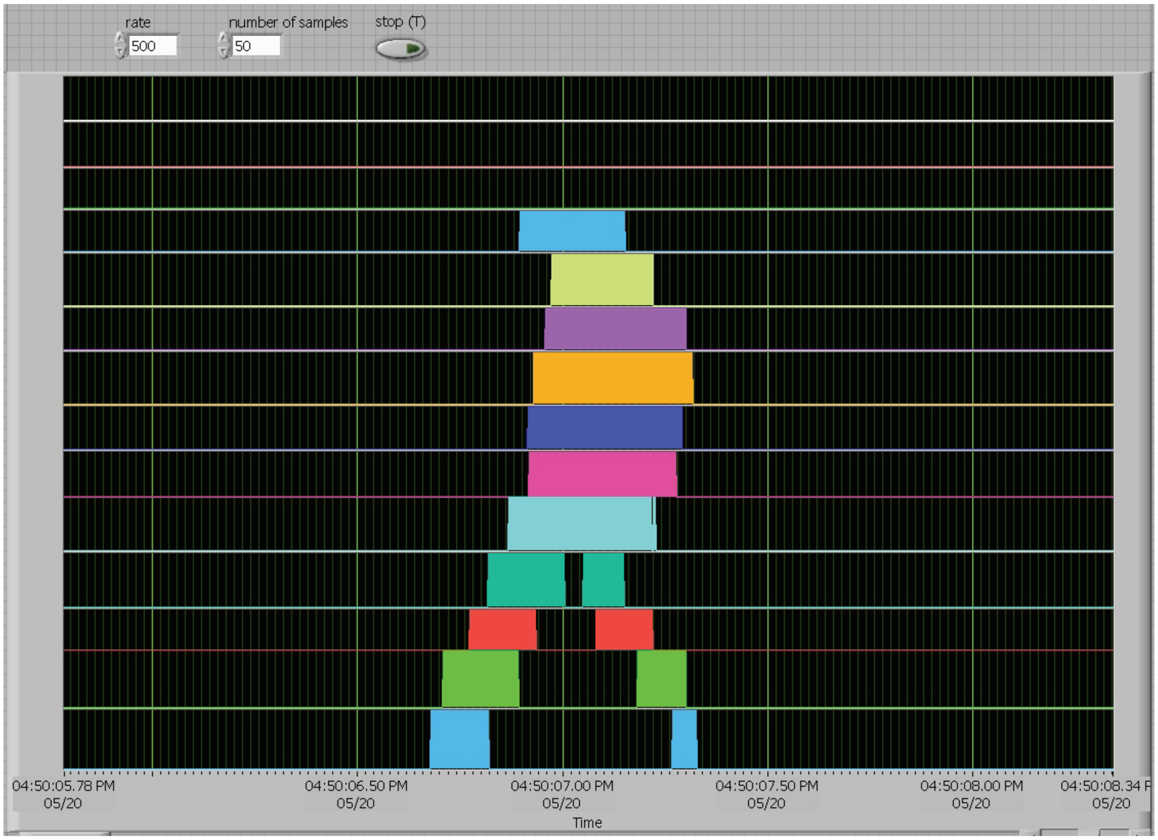

Figure 12. Profiling image used for the sample signature file.

The ability to count the number of objects crossing the scanner is another useful feature in many detection and identification applications. Figure 13 shows an example of this feature with an output image obtained with five objects going across the scanner, the number of count is indicted above the image. The count is implemented in software by counting the number of breaks in the beams. A count is accumulated when transition of any beam-break to no-beam-break occurs. Appendix C shows the LabVIEW Block Diagram of the software implementation portion of the counter.

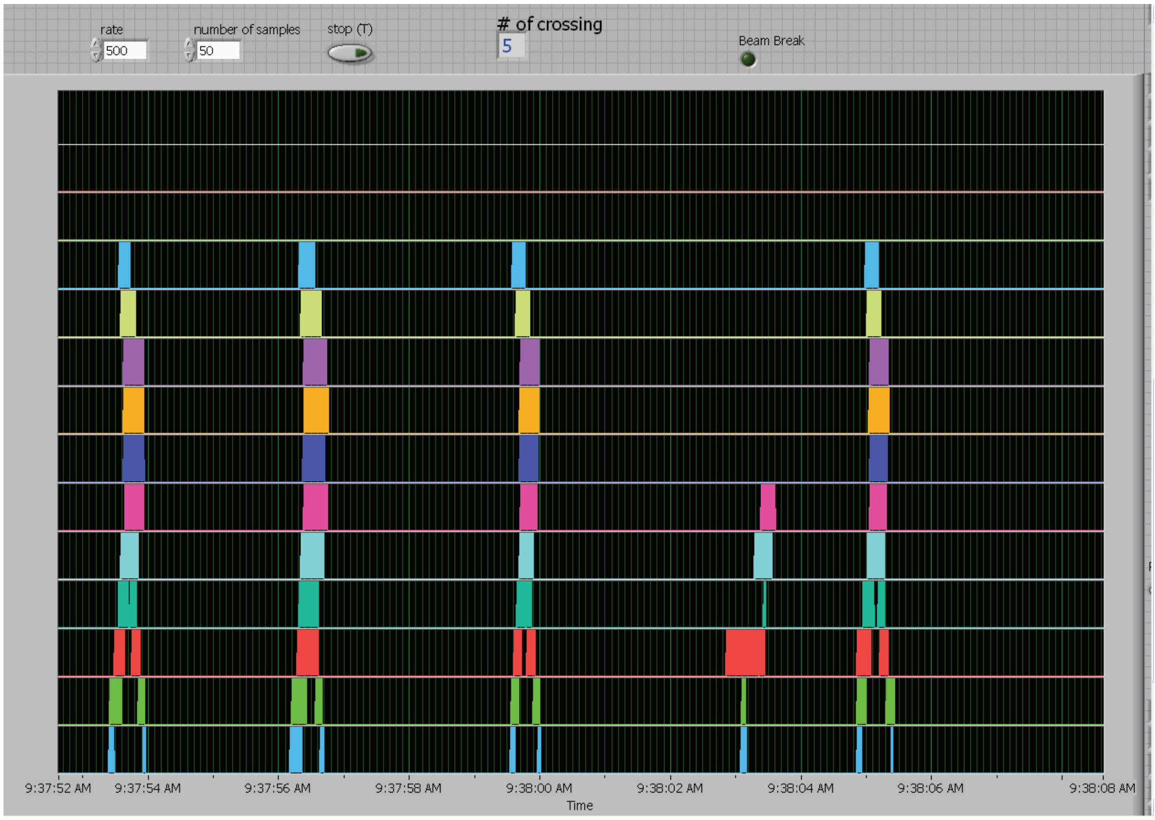

Figure 13. Scanner output showing counter feature.

5. Conclusions

We have developed a profiling scanner system using 16 laser diodes, 16 photo sensors, and a PC controller running LabVIEW that can provide the following capabilities:

1. Provide real-time moving profiling images showing the outline or shape of an object with enough details to distinguish different objects, for example between a person and a chair, a person carrying a back pack or holding an object.

2. Storing the image data into a file (in xls format) that can be used later as a signature file in classification systems to determine target classification.

3. Ability to count the number of object crossings.

These capabilities can be useful in such applications as detection of an illegal immigrant crossing a border, or as a supplement to other sensors in a battlefield for detection and identification confirmation of enemy troop and vehicle movements. Compared to systems using cameras, this

can be a lower cost alternative in terms of system complexity and operating data rate requirements.

With further study and investigation, performance of the scanner system can be enhanced. Following are some possible areas that may worth looking into:

1. Increasing the number of laser diodes and photo sensor to increase image resolution, and/or determining the optimum number needed to reliably classify different target types.

2. Use of non-visible IR to minimize detection by the enemy.

3. Use of collocated single scanning emitter and single detector to reduce the physical size of the scanner apparatus.

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Appendix A. LabVIEW Program

Front Panel of the LabVIEW program.

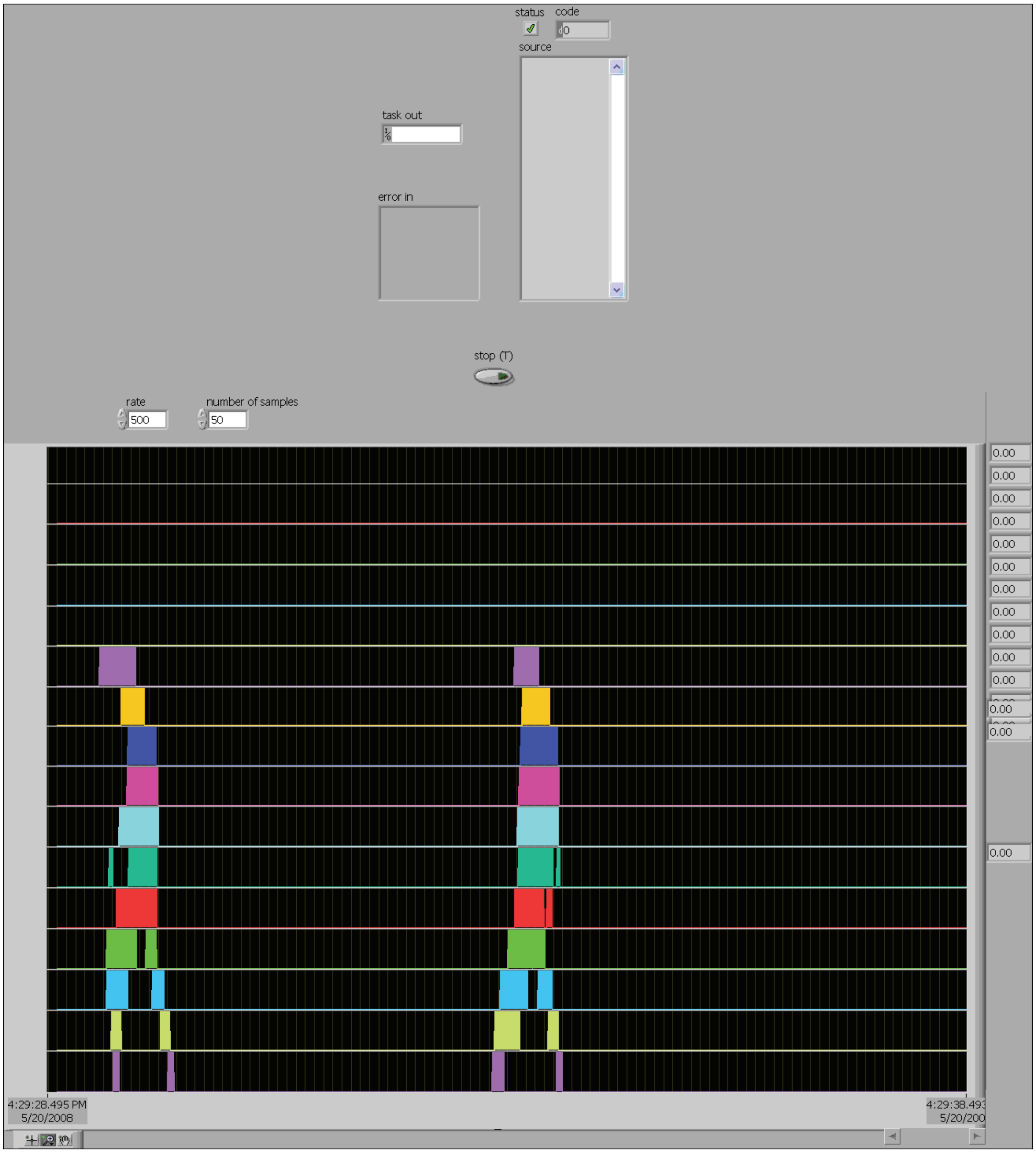

Figure A-1. Front panel view of Lab VIEW showing profiling of two people as they moved across the scanner.

Block Diagram of Labview Program

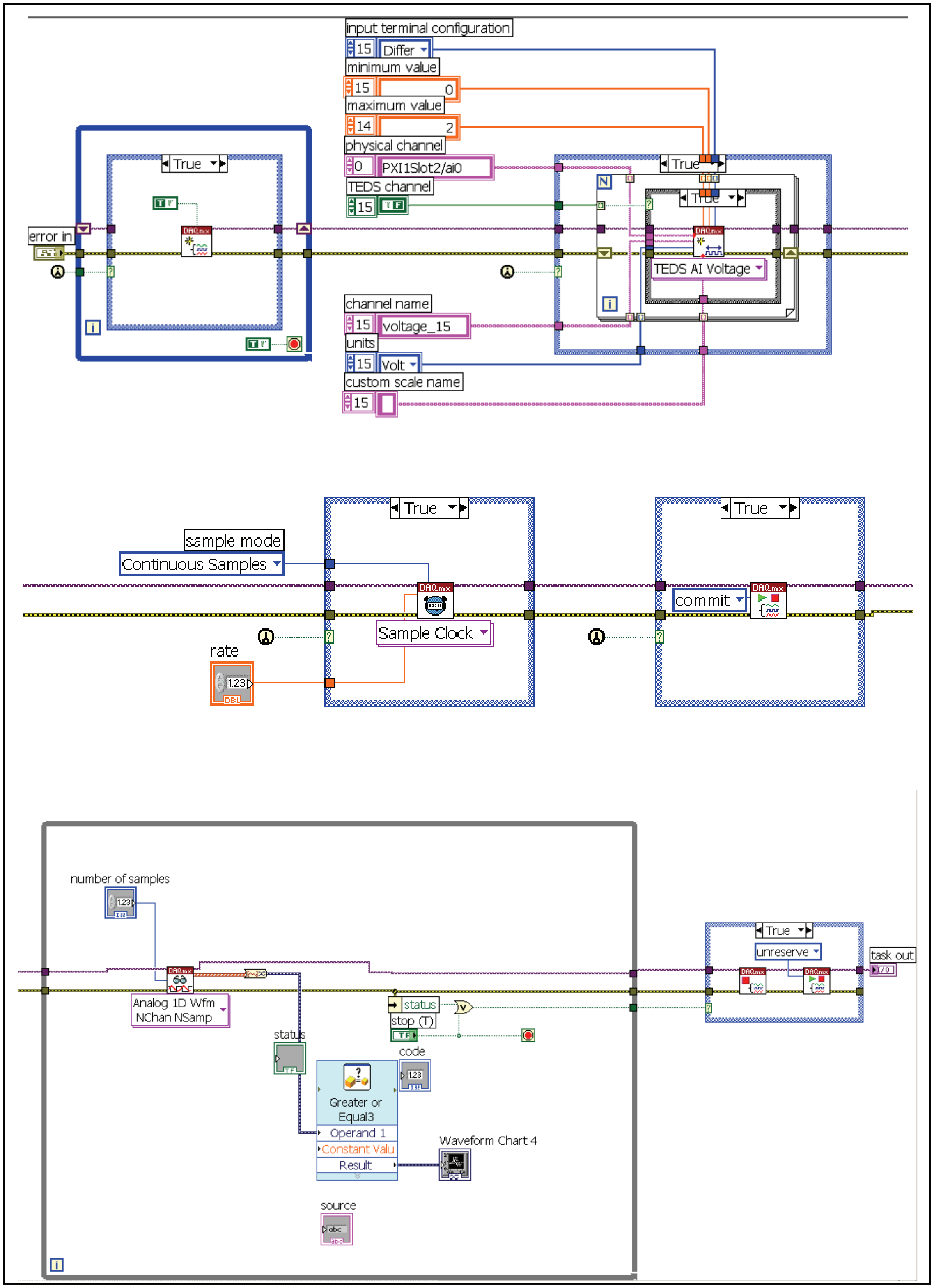

Figure A-2: Block Diagram of Labview Program.

Appendix B. Signature File in xls Format of Image in Figure 12

Table B-1. Output of the signature file.

Time	Y[0]	Y[1]	Y[2]	Y[3]	Y[4]	Y[5]	Y[6]	Y[7]	Y[8]	Y[9]	Y[10]	Y[11]	Y[12]	Y[13]
4:50:06.596 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.598 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.600 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.602 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.604 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.606 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.608 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.610 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.612 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.614 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.616 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.618 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.620 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.622 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.624 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.626 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.628 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.630 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.632 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.634 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.636 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.638 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.640 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.642 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.644 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.646 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.648 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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4:50:06.654 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.656 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.658 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.660 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.662 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.664 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.666 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.668 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table B-1. Output of the signature file (continued).

Time	Y[0]	Y[1]	Y[2]	Y[3]	Y[4]	Y[5]	Y[6]	Y[7]	Y[8]	Y[9]	Y[10]	Y[11]	Y[12]	Y[13]
4:50:06.670 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.672 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.674 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.676 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:06.678 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:50:06.680 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:50:06.682 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:50:06.684 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:50:06.686 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:50:06.688 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
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4:50:06.692 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:50:06.694 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:50:06.696 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:50:06.698 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:50:06.700 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:50:06.702 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:50:06.704 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:50:06.706 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:50:06.708 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.710 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.712 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.714 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.716 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.718 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.720 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.722 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.724 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.726 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
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4:50:06.734 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.736 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.738 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.740 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.742 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.744 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.746 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.748 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.750 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.752 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.754 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1

Table B-1. Output of the signature file (continued).

Time	Y[0]	Y[1]	Y[2]	Y[3]	Y[4]	Y[5]	Y[6]	Y[7]	Y[8]	Y[9]	Y[10]	Y[11]	Y[12]	Y[13]
4:50:06.756 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.758 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.760 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.762 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.764 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.766 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.768 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.770 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.772 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:50:06.774 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.776 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.778 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.780 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.782 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.784 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.786 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.788 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.790 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.792 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.794 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.796 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.798 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.800 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.802 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.804 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.806 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.808 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.810 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.812 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.814 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.816 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
4:50:06.818 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	1
4:50:06.820 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	1
4:50:06.822 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.824 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.826 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.828 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.830 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.832 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.834 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.836 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.838 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.840 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.842 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.844 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0

Table B-1. Output of the signature file (continued).

Time	Y[0]	Y[1]	Y[2]	Y[3]	Y[4]	Y[5]	Y[6]	Y[7]	Y[8]	Y[9]	Y[10]	Y[11]	Y[12]	Y[13]
4:50:06.846 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.848 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.850 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.852 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.854 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.856 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.858 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.860 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.862 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.864 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.866 PM	0	0	0	0	0	0	0	0	0	0	1	1	1	0
4:50:06.868 PM	0	0	0	0	0	0	0	0	0	1	1	1	1	0
4:50:06.870 PM	0	0	0	0	0	0	0	0	0	1	1	1	1	0
4:50:06.872 PM	0	0	0	0	0	0	0	0	0	1	1	1	1	0
4:50:06.874 PM	0	0	0	0	0	0	0	0	0	1	1	1	1	0
4:50:06.876 PM	0	0	0	0	0	0	0	0	0	1	1	1	1	0
4:50:06.878 PM	0	0	0	0	0	0	0	0	0	1	1	1	1	0
4:50:06.880 PM	0	0	0	0	0	0	0	0	0	1	1	1	1	0
4:50:06.882 PM	0	0	0	0	0	0	0	0	0	1	1	1	1	0
4:50:06.884 PM	0	0	0	0	0	0	0	0	0	1	1	1	1	0
4:50:06.886 PM	0	0	0	0	0	0	0	0	0	1	1	1	1	0
4:50:06.888 PM	0	0	0	0	0	0	0	0	0	1	1	1	1	0
4:50:06.890 PM	0	0	0	0	0	0	0	0	0	1	1	1	1	0
4:50:06.892 PM	0	0	0	0	0	0	0	0	0	1	1	1	1	0
4:50:06.894 PM	0	0	0	0	0	0	0	0	0	1	1	1	0	0
4:50:06.896 PM	0	0	0	1	0	0	0	0	0	1	1	1	0	0
4:50:06.898 PM	0	0	0	1	0	0	0	0	0	1	1	1	0	0
4:50:06.900 PM	0	0	0	1	0	0	0	0	0	1	1	1	0	0
4:50:06.902 PM	0	0	0	1	0	0	0	0	0	1	1	1	0	0
4:50:06.904 PM	0	0	0	1	0	0	0	0	0	1	1	1	0	0
4:50:06.906 PM	0	0	0	1	0	0	0	0	0	1	1	1	0	0
4:50:06.908 PM	0	0	0	1	0	0	0	0	0	1	1	1	0	0
4:50:06.910 PM	0	0	0	1	0	0	0	0	0	1	1	1	0	0
4:50:06.912 PM	0	0	0	1	0	0	0	0	0	1	1	1	0	0
4:50:06.914 PM	0	0	0	1	0	0	0	0	0	1	1	1	0	0
4:50:06.916 PM	0	0	0	1	0	0	0	1	0	1	1	1	0	0
4:50:06.918 PM	0	0	0	1	0	0	0	1	1	1	1	1	0	0
4:50:06.920 PM	0	0	0	1	0	0	0	1	1	1	1	1	0	0
4:50:06.922 PM	0	0	0	1	0	0	0	1	1	1	1	1	0	0
4:50:06.924 PM	0	0	0	1	0	0	0	1	1	1	1	1	0	0
4:50:06.926 PM	0	0	0	1	0	0	0	1	1	1	1	1	0	0
4:50:06.928 PM	0	0	0	1	0	0	0	1	1	1	1	1	0	0
4:50:06.930 PM	0	0	0	1	0	0	1	1	1	1	1	1	0	0

Table B-1. Output of the signature file (continued).

Time	Y[0]	Y[1]	Y[2]	Y[3]	Y[4]	Y[5]	Y[6]	Y[7]	Y[8]	Y[9]	Y[10]	Y[11]	Y[12]	Y[13]
4:50:06.932 PM	0	0	0	1	0	0	1	1	1	1	1	1	0	0
4:50:06.934 PM	0	0	0	1	0	0	1	1	1	1	1	1	0	0
4:50:06.936 PM	0	0	0	1	0	0	1	1	1	1	1	0	0	0
4:50:06.938 PM	0	0	0	1	0	0	1	1	1	1	1	0	0	0
4:50:06.940 PM	0	0	0	1	0	0	1	1	1	1	1	0	0	0
4:50:06.942 PM	0	0	0	1	0	0	1	1	1	1	1	0	0	0
4:50:06.944 PM	0	0	0	1	0	0	1	1	1	1	1	0	0	0
4:50:06.946 PM	0	0	0	1	0	0	1	1	1	1	1	0	0	0
4:50:06.948 PM	0	0	0	1	0	0	1	1	1	1	1	0	0	0
4:50:06.950 PM	0	0	0	1	0	0	1	1	1	1	1	0	0	0
4:50:06.952 PM	0	0	0	1	0	0	1	1	1	1	1	0	0	0
4:50:06.954 PM	0	0	0	1	0	0	1	1	1	1	1	0	0	0
4:50:06.956 PM	0	0	0	1	0	0	1	1	1	1	1	0	0	0
4:50:06.958 PM	0	0	0	1	0	1	1	1	1	1	1	0	0	0
4:50:06.960 PM	0	0	0	1	0	1	1	1	1	1	1	0	0	0
4:50:06.962 PM	0	0	0	1	0	1	1	1	1	1	1	0	0	0
4:50:06.964 PM	0	0	0	1	0	1	1	1	1	1	1	0	0	0
4:50:06.966 PM	0	0	0	1	0	1	1	1	1	1	1	0	0	0
4:50:06.968 PM	0	0	0	1	0	1	1	1	1	1	1	0	0	0
4:50:06.970 PM	0	0	0	1	0	1	1	1	1	1	1	0	0	0
4:50:06.972 PM	0	0	0	1	0	1	1	1	1	1	1	0	0	0
4:50:06.974 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:06.976 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:06.978 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:06.980 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:06.982 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:06.984 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:06.986 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:06.988 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:06.990 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:06.992 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:06.994 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:06.996 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:06.998 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.000 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.002 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.004 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.006 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.008 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.010 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.012 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.014 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.016 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0

Table B-1. Output of the signature file (continued).

Time	Y[0]	Y[1]	Y[2]	Y[3]	Y[4]	Y[5]	Y[6]	Y[7]	Y[8]	Y[9]	Y[10]	Y[11]	Y[12]	Y[13]
4:50:07.018 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.020 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.022 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.024 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.026 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.028 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.030 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.032 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.034 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.036 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.038 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.040 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.042 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.044 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.046 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.048 PM	0	0	0	1	1	1	1	1	1	1	0	0	0	0
4:50:07.050 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.052 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.054 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.056 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.058 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.060 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.062 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.064 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.066 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.068 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.070 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.072 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.074 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.076 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.078 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.080 PM	0	0	0	1	1	1	1	1	1	1	1	0	0	0
4:50:07.082 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.084 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.086 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.088 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.090 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.092 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.094 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.096 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.098 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.100 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.102 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.104 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0

Table B-1. Output of the signature file (continued).

Time	Y[0]	Y[1]	Y[2]	Y[3]	Y[4]	Y[5]	Y[6]	Y[7]	Y[8]	Y[9]	Y[10]	Y[11]	Y[12]	Y[13]
4:50:07.106 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.108 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.110 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.112 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.114 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.116 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.118 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.120 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.122 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.124 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.126 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.128 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.130 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.132 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.134 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.136 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.138 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.140 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.142 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.144 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.146 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.148 PM	0	0	0	1	1	1	1	1	1	1	1	1	0	0
4:50:07.150 PM	0	0	0	1	1	1	1	1	1	1	0	1	0	0
4:50:07.152 PM	0	0	0	1	1	1	1	1	1	1	0	1	0	0
4:50:07.154 PM	0	0	0	0	1	1	1	1	1	1	0	1	0	0
4:50:07.156 PM	0	0	0	0	1	1	1	1	1	1	0	1	0	0
4:50:07.158 PM	0	0	0	0	1	1	1	1	1	1	0	1	0	0
4:50:07.160 PM	0	0	0	0	1	1	1	1	1	1	0	1	0	0
4:50:07.162 PM	0	0	0	0	1	1	1	1	1	1	0	1	0	0
4:50:07.164 PM	0	0	0	0	1	1	1	1	1	1	0	1	0	0
4:50:07.166 PM	0	0	0	0	1	1	1	1	1	1	0	1	0	0
4:50:07.168 PM	0	0	0	0	1	1	1	1	1	1	0	1	0	0
4:50:07.170 PM	0	0	0	0	1	1	1	1	1	1	0	1	0	0
4:50:07.172 PM	0	0	0	0	1	1	1	1	1	1	0	1	0	0
4:50:07.174 PM	0	0	0	0	1	1	1	1	1	1	0	1	0	0
4:50:07.176 PM	0	0	0	0	1	1	1	1	1	1	0	1	0	0
4:50:07.178 PM	0	0	0	0	1	1	1	1	1	1	0	1	0	0
4:50:07.180 PM	0	0	0	0	1	1	1	1	1	1	0	1	0	0
4:50:07.182 PM	0	0	0	0	1	1	1	1	1	1	0	1	0	0
4:50:07.184 PM	0	0	0	0	1	1	1	1	1	1	0	1	1	0
4:50:07.186 PM	0	0	0	0	1	1	1	1	1	1	0	1	1	0
4:50:07.188 PM	0	0	0	0	1	1	1	1	1	1	0	1	1	0
4:50:07.190 PM	0	0	0	0	1	1	1	1	1	1	0	1	1	0
4:50:07.192 PM	0	0	0	0	1	1	1	1	1	1	0	1	1	0

Table B-1. Output of the signature file (continued).

Time	Y[0]	Y[1]	Y[2]	Y[3]	Y[4]	Y[5]	Y[6]	Y[7]	Y[8]	Y[9]	Y[10]	Y[11]	Y[12]	Y[13]
4:50:07.194 PM	0	0	0	0	1	1	1	1	1	1	0	1	1	0
4:50:07.196 PM	0	0	0	0	1	1	1	1	1	1	0	1	1	0
4:50:07.198 PM	0	0	0	0	1	1	1	1	1	1	0	1	1	0
4:50:07.200 PM	0	0	0	0	1	1	1	1	1	1	0	1	1	0
4:50:07.202 PM	0	0	0	0	1	1	1	1	1	1	0	1	1	0
4:50:07.204 PM	0	0	0	0	1	1	1	1	1	1	0	1	1	0
4:50:07.206 PM	0	0	0	0	1	1	1	1	1	1	0	1	1	0
4:50:07.208 PM	0	0	0	0	1	1	1	1	1	1	0	1	1	0
4:50:07.210 PM	0	0	0	0	1	1	1	1	1	1	0	1	1	0
4:50:07.212 PM	0	0	0	0	1	1	1	1	1	1	0	1	1	0
4:50:07.214 PM	0	0	0	0	1	1	1	1	1	1	0	1	1	0
4:50:07.216 PM	0	0	0	0	1	1	1	1	1	1	0	1	1	0
4:50:07.218 PM	0	0	0	0	1	1	1	1	1	0	0	1	1	0
4:50:07.220 PM	0	0	0	0	1	1	1	1	1	0	0	0	1	0
4:50:07.222 PM	0	0	0	0	0	1	1	1	1	1	0	0	1	0
4:50:07.224 PM	0	0	0	0	0	1	1	1	1	1	0	0	1	0
4:50:07.226 PM	0	0	0	0	0	1	1	1	1	1	0	0	1	0
4:50:07.228 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.230 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.232 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.234 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.236 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.238 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.240 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.242 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.244 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.246 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.248 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.250 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.252 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.254 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.256 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.258 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.260 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.262 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.264 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.266 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	0
4:50:07.268 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	1
4:50:07.270 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	1
4:50:07.272 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	1
4:50:07.274 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	1
4:50:07.276 PM	0	0	0	0	0	1	1	1	1	0	0	0	1	1
4:50:07.278 PM	0	0	0	0	0	1	1	1	0	0	0	0	1	1
4:50:07.280 PM	0	0	0	0	0	1	1	1	0	0	0	0	1	1

Table B-1. Output of the signature file (continued).

Time	Y[0]	Y[1]	Y[2]	Y[3]	Y[4]	Y[5]	Y[6]	Y[7]	Y[8]	Y[9]	Y[10]	Y[11]	Y[12]	Y[13]
4:50:07.282 PM	0	0	0	0	0	1	1	1	0	0	0	0	1	1
4:50:07.284 PM	0	0	0	0	0	1	1	1	0	0	0	0	1	1
4:50:07.286 PM	0	0	0	0	0	1	1	1	0	0	0	0	1	1
4:50:07.288 PM	0	0	0	0	0	1	1	1	0	0	0	0	1	1
4:50:07.290 PM	0	0	0	0	0	1	1	1	0	0	0	0	1	1
4:50:07.292 PM	0	0	0	0	0	1	1	0	0	0	0	0	1	1
4:50:07.294 PM	0	0	0	0	0	1	1	0	0	0	0	0	1	1
4:50:07.296 PM	0	0	0	0	0	1	1	0	0	0	0	0	1	1
4:50:07.298 PM	0	0	0	0	0	1	1	0	0	0	0	0	1	1
4:50:07.300 PM	0	0	0	0	0	1	1	0	0	0	0	0	1	1
4:50:07.302 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	1
4:50:07.304 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	1
4:50:07.306 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	1
4:50:07.308 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	1
4:50:07.310 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	1
4:50:07.312 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	1
4:50:07.314 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	1
4:50:07.316 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	1
4:50:07.318 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:50:07.320 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:50:07.322 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:50:07.324 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:50:07.326 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:50:07.328 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.330 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.332 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.334 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.336 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.338 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.340 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.342 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.344 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.346 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.348 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.350 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.352 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.354 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.356 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.358 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.360 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.362 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.364 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.366 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.368 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table B-1. Output of the signature file (continued).

Time	Y[0]	Y[1]	Y[2]	Y[3]	Y[4]	Y[5]	Y[6]	Y[7]	Y[8]	Y[9]	Y[10]	Y[11]	Y[12]	Y[13]
4:50:07.370 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.372 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.374 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.376 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.378 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.380 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.382 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.384 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.386 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.388 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.390 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.392 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50:07.394 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix C. LabVIEW Block Diagram of Counter Algorithm

Figure C-1 shows the LabVIEW Block Diagram of Counter Algorithm.

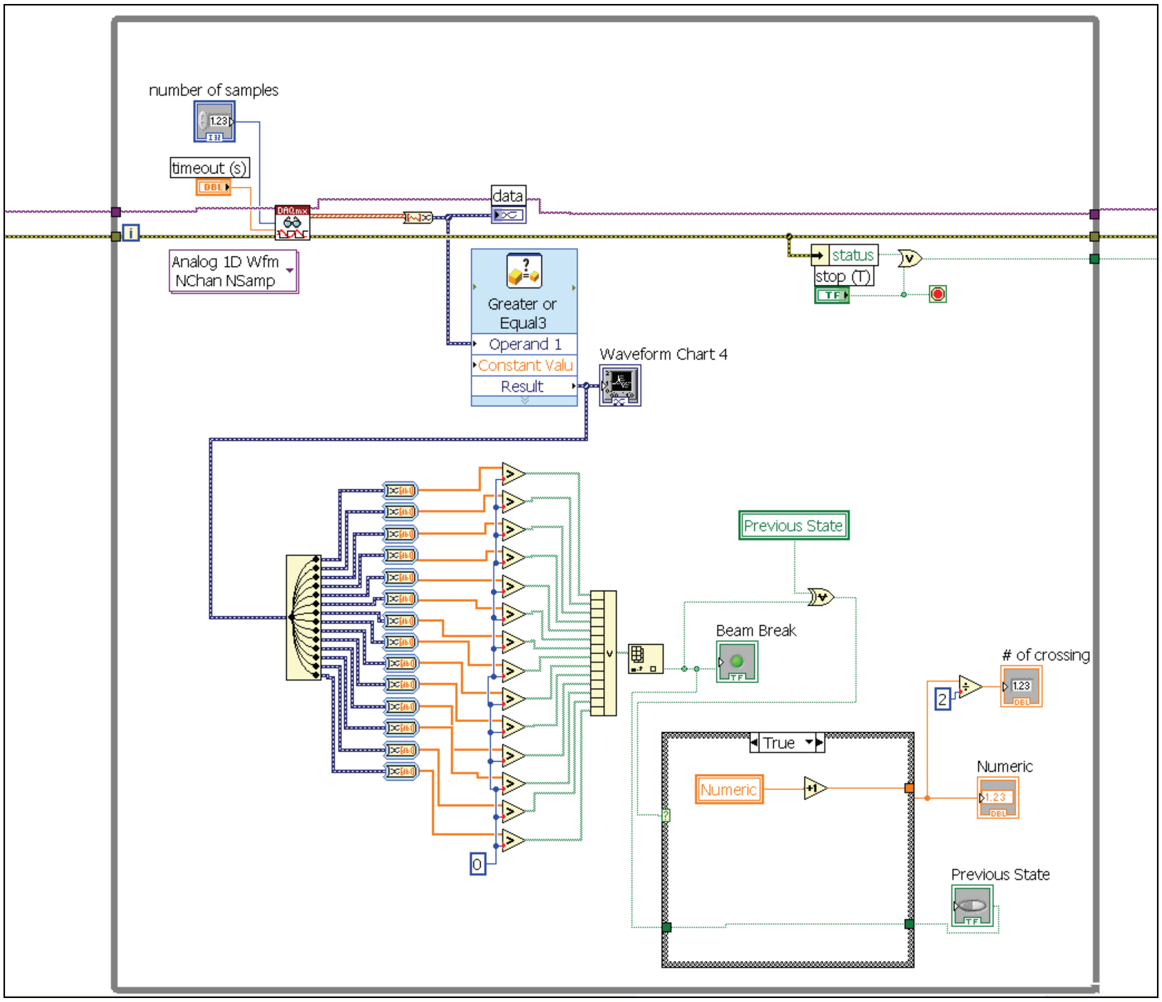

Figure C-1. LabVIEW block diagram of counter algorithm.

Acronyms

2-D	two-demensional
ARL	U.S. Army Research Laboratory
DAQ	data acquisition module
DC	direct current
ma	milliamp – one thousandth of an ampere
mW	milliwatt – one thousandth of a watt
PC	personal computer
SEDD	Sensors and Electron Devices Directorate

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